LIFEPAC®

SCIENCE

STUDENT BOOK

▶ **8th Grade |** Unit 7

Alpha Omega
PUBLICATIONS

SCIENCE 807
Machines 1

LIFEPAC Test is located in the center of the booklet. Please remove before starting the unit.

Author:
Shirley A. Johnson, M.N.S.
Lee H. Dunning, M.S.T., M.S.Ed.

Editor:
Richard W. Wheeler, M.A.Ed
Consulting Editor:
Harold Wengert, Ed.D
Revision Editor:
Alan Christopherson, M.S

Westover Studios Design Team:
Phillip Pettet, Creative Lead
Teresa Davis, DTP Lead
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Introduction

All of the people in the world have had to work for a living since Adam and Eve were expelled from the garden of Eden (Genesis 3). In this LIFEPAC® you will learn about work as a scientist views it and about distance, force, and friction.

Do you work? Whenever you pick something up or move it against friction you perform work

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. When you have finished this LIFEPAC, you should be able to:

1. Measure distances in the metric and English systems.

2. Measure distances indirectly.

3. Define force.

4. Construct force diagrams.

5. Solve problems involving forces.

6. Explain and to apply Newton's Laws of motion.

7. Define work and energy.

8. Solve problems involving work and power.

1. DISTANCE

When you were small, distances were limited to your house and your yard. As you got older, your activities covered greater areas and your range increased to include church, school, homes of friends, and the streets joining those places.

Distance has varied meanings to people of different times and places. Society has therefore developed systems of measurement. Specific dimensions enable everyone to understand what is meant regardless of who is measuring or what is being measured.

SECTION OBJECTIVES

Review these objectives. When you have completed this section, you should be able to:

1. Measure distances in the metric and English systems.
2. Measure distances indirectly.

VOCABULARY

Study these words to enhance your learning success in this section.

cubit (kyü´ bit). An ancient measure of length equal to 18 or 22 inches.

English system (Ing´ glish sis´ tum). The system of measurement that includes units like foot, pound, and gallon.

metric system (met´ rik sis´tum). A system of measurement based on the meter as a unit of length.

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.*

Pronunciation Key: h**a**t, **ā**ge, c**ã**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u̇**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /*ŦH*/ for **th**en; /*zh*/ for mea**s**ure; /*u*/ represents /*a*/ in **a**bout, /*e*/ in tak**e**n, /*i*/ in penc**i**l, /*o*/ in lem**o**n, and /*u*/ in circ**u**s.

DESCRIBING DISTANCE

Have you given someone directions to get to your house from school? What words did you use to describe the distance between the two places? In this section you will study ways to express distance.

Comparison. Many societies have no words to compare. One word may be used for *building* with no way to tell if the building is a tool shed or a skyscraper. Sometimes words, such as *far* or *near, large* or *small, high* or *low,* are as good as, or better than, exact measurement. Comparative words such as these can be used accurately in descriptions. People who use comparative words in conversation need more exact terms at other times.

With numbers. Over a period of several thousand years, people developed systems of measurement of distance. In Genesis 6 God commanded Noah to build an ark that was to be 300 **cubits** long, 50 cubits wide, and 30 cubits high. A cubit was the length of a forearm—from 46 to 56 centimeters (18 to 22 inches) long. The cubit, however, varied with the length of the arm. Another measurement from that portion of history was a *step* or a *pace.* The word *mile*

comes from the Latin term for a thousand paces.

In the United States the common units used to measure distance are the *inch, foot, yard,* and *mile.* The problem with this system is the conversion from one unit to another. We have all learned that 5,280 feet equals a mile. A mile therefore is 63,360 inches, or 1,760 yards. Converting dimensions from feet to inches or from miles to feet requires clumsy multiplication or division. Engineers have used decimals to express fractions; but few others use decimals to express parts of feet, inches, or miles in the **English system**.

The history of the English system of units indicates that its origins are varied. At one time *inch* was the length of three dried barley corns laid end to end. At another time the inch was the width of a man's thumb. The *yard* was defined in 1120 AD by King Henry I of England as the distance from the end of his thumb to the tip of his nose when his arm was level.

France adopted the **metric system** in 1793. It was an entirely new system of measurement. The metric system is exact and easy to use because it is based on the decimal system, or multiples of ten. The metric system is used by scientists all over the world. In 1866 Congress legalized the use of the metric system in the United States. The Congress passed the Metric Conversion Act in 1975. However, each of these acts called for voluntary changeover and so very few Americans have learned the metric system. Therefore, the metric system is unfamiliar to most people in the United States. Using this system will require practice. Learning the metric system is like learning rules for a new game. The metric system will be used in most cases in this LIFEPAC.

The modern metric system is known as the International System of Units. The name International System of Units with the international abbreviation SI was given to the system by the General Conference on Weights and Measures in 1960.

In the SI system (from the French, *Systeme International d'Unites*) the fundamental unit of distance is the meter. For comparison, a meter is a little longer than a yard. A meter is divided into 100 units called *centimeters* and into 1,000 units called *millimeters.* The width of a large wire paper clip is about a centimeter and the diameter of the wire is about a millimeter. For long distances the convenient unit is the *kilometer,* 1,000 meters.

Match these items.

1.1	_____ Jeff's house is near school.	a. comparative
1.2	_____ Sheri is nearly home.	b. numerical
1.3	_____ Uncle Bob drives twenty miles to work.	c. neither
1.4	_____ Jan is closer than Debbie to the goal.	
1.5	_____ February is shorter than June.	
1.6	_____ Dr. Davis is taller than Dr. Brown.	
1.7	_____ Dr. Davis is over six feet tall.	

Try this investigation to build your own cubit.

These supplies are needed:

- 10 strips of paper about 5 cm wide and at least 62 cm long
- scissors
- tape
- string

Follow these directions and answer the questions. Put a check in the box when each step is completed.

☐ 1. Ask each of ten students to place his forearm with fingers outstretched on a strip of paper. Mark the position of the elbow and the tip of the middle finger on each strip.

☐ 2. Trim the excess paper from the ends of each strip.

☐ 3. Organize the strips parallel to each other in order of length and tape one end of each along the edge of a table.

1.8 Do the strips vary in length? _____

1.9 Which strip represents a cubit? _____

_____

Standardized Measurement Experiment

☐ 4. Along some straight line (the wall, a floor board, an aisle) lay off twelve longest "cubits." Mark the starting point and the end.

☐ 5. From the same starting point lay off twelve shortest "cubits."

1.10 Using a shortest cubit as a unit of length (the same way you would use a ruler), what is the difference between twelve longest cubits and twelve shortest cubits?

_____

_____

☐ 6. Substitute a length of string for a strip of paper and remeasure a forearm.

1.11 What disadvantage is obvious in the use of string? _____

_____

1.12 What common procedure could be used to make your classroom cubit more acceptable as a standard unit of length? _____

_____

1.13 How could you communicate the length of your classroom cubit to a science class in another school? _____

_____

Some things can be measured by counting. One example is the number of students in your class. Other things are measured using numbers but do not require counting; for instance, the distance from home to school.

Standardized Measurement Experiment

Write count before each quantity that is measured by counting.

1.14 _____ number of teachers in your school

1.15 _____ yesterday's high temperature

1.16 _____ length of the hall

1.17 _____ number of coins in a coin collection

1.18 _____ value of a coin in the collection

1.19 _____ number of centimeters in your height

1.20 _____ number of milliliters of water in a glass

1.21 _____ number of fans in a stadium

Answer these questions.

1.22 How could you find out, without counting, if more desks or more students were in a room?

_____

_____

1.23 How could you find out, without measuring, which of two cows gave more milk?

_____

_____

1.24 Without using numbers, how could you tell a store clerk the length of shoelace you need

for your left sneaker? _____

_____

1.25 Without using a ruler, which line is longer, or are the lines the same length?

_____

A   **B**

1.26 How did you discover the answer to 1.25? _____

_____

Measure the following objects with a pac.

| 1 pac = the width of the front cover of this LIFEPAC. |

1.27 Measure the longer dimension of your desk top in pacs. _____

1.28 Measure the shorter dimension of your desk top in pacs. _____

1.29 Measure the length of your classroom in pacs. _____

1.30 Measure the width of your pen or pencil in pacs. _____

_____

TEACHER CHECK _____ _____

initials   date

Answer these questions.

1.31 What disadvantages are built into the pac as a standard unit of length? _____

_____

_____

1.32 How could you use the front cover of this LIFEPAC to measure the width of your pen or

pencil? _____

_____

_____

1.33 What clue does activity 1.32 give to the development of the English system? _____

_____

_____

Multiply or divide to make these English distance conversions. Time yourself as you do the ten exercises without a calculator.

| 1 mile | = | 5,280 | feet |

1.34 174 inches = _____ feet

1.35 7 feet = _____ inches

1.36 29 feet = _____ yards

1.37 29 feet = _____ inches

1.38 3 miles = _____ feet

1.39 10,000 feet = _____ miles

1.40 10,000 feet = _____ yards

1.41 10,000 feet = _____ inches

1.42 79 yards = _____ feet

1.43 100 yards = _____ feet

Answer these questions.

1.44 How long did you take to work 1.34-1.43? _____

1.45 Which of the conversions were easier or faster than the rest? _____

_____

1.46 Why were the conversions easier? _____

_____

Multiply or divide to make these metric distance conversions. Time yourself as you do the ten exercises without a calculator.

> 1 kilometer = 1,000 meters
>
> 1 meter = 100 centimeters or 1,000 millimeters

1.47 174 centimeters= _____ meters

1.48 7 meters = _____ centimeters

1.49 29 centimeters = _____ millimeters

1.50 29 centimeters = _____ meters

1.51 3 kilometers = _____ meters

1.52 10,000 meters = _____ kilometers

1.53 10,000 meters = _____ centimeters

1.54 10,000 meters = _____ millimeters

1.55 79 millimeters = _____ centimeters

1.56 1,000 meters = _____ kilometers

Answer these questions.

1.57 How long did you take to work 1.47-1.56? _____

1.58 Explain the difference in your times. _____

_____

_____

Research and report.

1.59 Use outside sources to research one of these topics.

Isaac Newton   Robert Boyle

Nicolaus Copernicus   history of metric or English system

The report should be at least five handwritten, double-spaced pages including a short bibliography. Especially include a section on their Christian testimony.

TEACHER CHECK _____ _____

initials   date

SELF TEST 1

Write the letter of the correct choice (each answer, 2 points).

**1.01** The cubit was known as early as _____ .
a. 1750   b. 1400   c. AD 1   d. 2500 BC

1.02 The metric system was devised by _____ .
a. Sophocles   b. Moses   c. the Romans   d. the French

1.03 The system of measurements that includes the foot, yard, and mile is the _____ system.
a. English   b. French   c. metric   d. electric

1.04 A mile contains _____ feet.
a. 63,360   b. 5,280   c. 1,492   d. 1,000

1.05 In the United States the metric system is most commonly used by _____ .
a. auto mechanics   b. grocers   c. scientists   d. bus drivers

Make these conversions (each answer, 3 points).

1.06 10 cm = _____ mm

1.07 100 cm = _____ m

1.08 25 m = _____ cm

1.09 73 m = _____ mm

1.010 147 mm = _____ m

Calculate these distances (each answer, 5 points).

1.011 Use the scale drawing to find the actual distance AB.
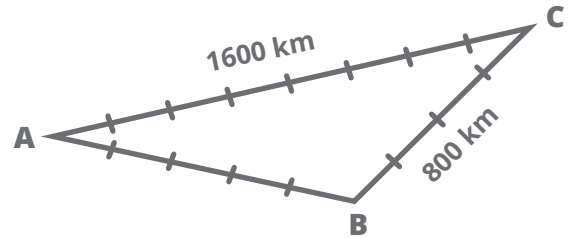
1.012 Use a scale drawing to find the height of a tree if it casts a shadow 30 m and the line from the top of the tree to the top of the shadow forms an angle of 45° with the ground.

Complete these sentences (each answer, 3 points).

1.013 Measuring the distance to a planet would probably require the use of _____ (direct, indirect) measurement.

1.014 The system of mathematics used for, among other things, surveying and indirect measurements is _____ .

1.015 The term that means 1,000 meters is _____ .

1.016 The metric system is based on multiples of the number _____ .

1.017 The fundamental unit of length in the metric system is the _____ .

1.018 An educated guess of a distance is a(n) _____ .

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